Remarks/Arguments

Applicants hereby request further examination of the subject application in view of the amendments and remarks presented herein.

Claim Rejections – 35 USC § 112

Claim 1 is rejected under 35 USC § 112, first paragraph, as failing to comply with the written description requirement. Applicants respectfully traverse the rejection.

Figure 2 and paragraph [0015] of the application fully describes the invention embodiment of Claim 1 as previously amended. The transitional phrase "consisting of" excludes any element, step, or ingredient not specified in the claim. Each element of Claim 1 is shown in Figure 2 and no additional elements are shown. The written description includes the original specification and the drawings, therefore, the transitional phrase "consisting of" is completely taught by considering the applicants' figures and written description in combination.

The rejection is overcome, and applicant respectfully requests withdrawal thereof.

Claim Rejections – 35 USC § 103

Claim 1 is rejected under 35 USC § 103(a) as being unpatentable over Gittleman et al. (US 6,694,692) in view of Asou et al. (US 2002/0150800 A1). Applicants respectfully traverse the rejection.

Gittleman in combination with Asou does not teach or claim the applicants' invention. Firstly, both Gittleman and Asou teach that shift reactors are essential to their inventions. Gittleman teaches, col. 1, lines 50-54, that "Reactors downstream of the primary reactor are REQUIRED to lower the CO concentration in the hydrogen-rich reformats (sic) to levels tolerable in the fuel cell stack. Downstream reactors may include a water/gas shift (WGS) reactor and a preferential oxidizer (PROX) reactor." Asou teaches in paragraph [0038], "A raw material supplied from the material supply unit 1 is reformed in the reforming unit 3; the reformed gas flows into a shifting unit 4 filled with a shifting catalyst to be shifted; and the shifted gas flows into a purifying unit 5 filled with a CO removing (purifying) catalyst to be purified." Thus, Asou teaches a catalytic chemical process in purifying unit 5 whereas the

applicants' invention teaches only physical processes for the purification/scrubbing of a gas to recycle it to the reforming reactor. Further, Asou teaches that the purified gas is, in part, directed to a burner 8 [¶ [0038]]. This teaches away from the applicants' invention in that the applicants recycle to the reforming reactor. Further, Asou does not cool the gas between the shifting unit 4, which yields a gas at 400°C, and the purifying unit 5. Further, Asou does not teach a "scrubber", but instead teaches a purifying unit 5 which is not a scrubber by definition.

The Gittleman portion of the combination also teaches, col. 2, lines 38-41, that "The present invention advantageously eliminates the use of a preferential oxidation (PROX) reactor, by providing an apparatus which incorporates CO adsorption in the place of the PROX reactor." Gittleman further teaches, col. 2, lines 8-13, "Thus, it is desirable to have a fuel processor in a hydrogen fuel cell engine which provides a means to reduce the carbon monoxide content under normal operation before entering the fuel cell stack, thereby advantageously eliminating the use of a preferential oxidizer (PROX) reactor, or significantly reducing the size of any such reactor." Gittleman teaches, col. 2, lines 30-34, "The apparatus comprises a vessel housing an adsorbent adapted to adsorb the carbon monoxide. The vessel may be a rotating pressure swing adsorber. The apparatus further comprises a water gas shift reactor upstream of the rotating pressure swing adsorber, …" Gittleman teaches that "One of the advantages of the present invention is the possibility of using only a high temperature water gas shift reactor, which is generally smaller than a low temperature water gas shift reactor, or a system with both high and low temperature water gas shift reactors, even though the high temperature water gas shift reactor does not reduce the CO to very low levels due to equilibrium constraints. This is possible because of the ability of the adsorber to handle relatively high CO levels that cannot be tolerated by conventional systems that use preferential oxidation (PROX) reactors to convert CO to CO_2." Gittleman does not teach the possibility of using no water gas shift reactor, and nowhere does Gittleman teach the elimination of the water gas shift reactor. Thus, both Gittleman and Asou teach away from the applicants' invention in that the combination teaches the necessity of reactors downstream of the primary reactor including WGS and PROX reactors.

In contrast, the applicants specifically teach and claim that no water gas shift reactor is required, for example, at paragraph [0002], "…using a carbon foam heat exchanger and carbon fiber composite molecular sieve scrubber instead of conventional desulfurizers, SHIFT

REACTORS, and partial oxidation reactors". And in Claim 1, the closed transitional phrase "consisting of" is used to exclude any element, e.g. shift reactor, not specified in the claim.

Secondly, with regard to the overlap of the CO concentration of 1-20 % that typically comes from the primary reactor, and 0.5-5 % that typically comes from the water gas shift reactor, this relates directly to Gittleman's teaching that an advantage of his invention is the possibility of using "…only a high temperature water gas shift reactor…" Gittleman teaches, col. 3, lines 28-30, that the "…carbon monoxide concentration in stream 12 is typically between about 1 mole % and about 20 mole %." This means the concentration of CO in stream 12 cannot be assured to be less than 5 %, which is the highest concentration of CO that Gittleman teaches his adsorber can handle, and thus Gittleman's device cannot work without a water gas shift reactor unless he restricts the CO in gas stream 12 to 0.5-5 %. Thus, Gittleman teaches that if and only if the reformate gas leaving reactor 1 is less than 5 % could the water gas shift reactor be eliminated. In contrast, the applicants system eliminates the water gas shift reactor regardless of the CO concentration in the reformate gas leaving reactor 1 because of the high CO adsorptive capacity of the scrubber.

The CO concentration from Gittleman's water gas shift reactor that employs both a high temperature and low temperature shift is at the lower end of the range, 0.5-5 %, whereas the CO concentration from a water gas shift reactor that employs only a high temperature shift is at the upper end of the range, 0.5-5 %. Gittleman teaches, col. 3, lines 63-67 and col. 4, lines 1-12, that his adsorber can handle reformate with CO concentrations ranging from 0.5-5 %. In contrast, the applicants' adsorber inherently functions at CO concentrations outside of Gittleman's range; 0.035-0.5 % as well as 20-100%, because no range limitation is taught or claimed by the applicants.

The rejection is overcome, and applicant respectfully requests withdrawal thereof.

Applicants confirm that no new matter is introduced with these amendments. In view of the above amendments and remarks, it is submitted that the Examiner's rejections are overcome, and that applicant's claims are in condition for allowance. Applicants therefore earnestly solicit allowance thereof, and the issue of U.S. letters patent therefore.

Respectfully submitted:

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